User Interface Design Document for the Land Information System

Submitted under Task Agreement GSFC-CT-2

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Increasing Interoperability and Performance of Grand Challenge Applications in the Earth, Space, Life, and Microgravity Sciences

Version 4.0

Revision history:

Version	***Summary of Changes***	***Date***
1.0	Initial Release	3/15/03
2.0	Milestone I Update	7/30/03
3.0	Milestone C Draft	7/30/04
4.0	Milestone K Submission	2/11/05

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Acronyms and Terms

AGRMET: Agriculture Meteorology Model

AVHRR: Advanced Very High Resolution Radiometer

CGI: Common Gateway Interface

CLM: Community Land Model

COLA: Center for Ocean-Land-Atmosphere Studies

DAO: Data Assimilation Office

DODS: Distributed Ocean Data System

ECMWF: European Center for Medium-Range Weather Forecasts

EOS: Earth Observing System

HTTP: File Transfer Protocol

HDF: Hierarchical Data Format

GOES: Geostationary Operational Environmental Satellite

GrADS: Grid Analysis and Display System

GRIB: Gridded Binary

LDAS: Land Data Assimilation System

LRD: LIS Requirements Document

LIS: Land Information System

NET-CDF: Network Common Data Form

NOAH: National Centers for Environmental Prediction, Oregon State University, United States Air Force, and Office of Hydrology Land Surface Model

NVDOS: National Virtual Oceanographic Data System

NRL: Naval Research Laboratory

TBD: To Be Determined

TRMM: Tropical Rainfall Measuring Mission

USGS: United States Geological Survey

VIC: Variable Infiltration Capacity

1 Introduction

This User Interface Design Document establishes the user interface design for the Land Information System (LIS). LIS is a project to build a high-resolution, high-performance land surface modeling and data assimilation system to support a wide range of land surface research activities and applications.

This document has been prepared as part of Task Agreement GSFC-CT-2 under Cooperative Agreement Notice CAN-00-OES-01 Increasing Interoperability and Performance of Grand Challenge Applications in the Earth, Space, Life, and Microgravity Sciences, funded by NASA's ESTO Computational Technologies (formerly High Performance Computing and Communications) Project.

1.1 Purpose and goals

This document serves as the blueprint for the user interface of the Land Information System (LIS).

The design goals of LIS user interface are to allow Internet users access to LIS data by using data mining, numerical modeling, and visualization tools provided by the Grid Analysis and Display System and the Distributed Oceanographic Data System, or the GrADS-DODS Server (LRD, Sec 2.1), the Live Access Server, or downloading the raw data using HTTP.

1.2 Scope

This document covers the design of all the LIS user interface components for the three-year duration of the LIS project. The document focuses primarily on the implementation of the LIS user interface running on a Linux cluster, with users accessing LIS data through Netscape/IE 4.x or higher. This document does not cover design for other hardware/software platforms.

2 User interface components

The user interface subsystem takes a typical multi-tier client-server system architecture. On the client side, a user has two types of client programs to use as the front-end: a web browser, or a DODS client program. On the server side, a general-purpose web server will be used to serve clients with a web browser, and a GrADS-DODS server will be deployed to serve DODS clients, and a HTTP server to serve http clients. Besides theses components, CGI scripts and CGI-GrADS gateway scripts will be used as the middleware to perform dynamic processing based on users' interactive requests sent through web browsers. Figure 1 shows the user interface architecture design.

The user interface of LIS is an important component of LIS that will allow the interactive, flexible use of the LIS hardware and software to users. The LIS user interface is intended to be web-based, and designed to allow for cascading complexity depending on the level of user's need to control the system. Users accessing the LIS are

categorized into three levels, associated with different levels of data access and security requirements (LRD, Sec. 6.1).

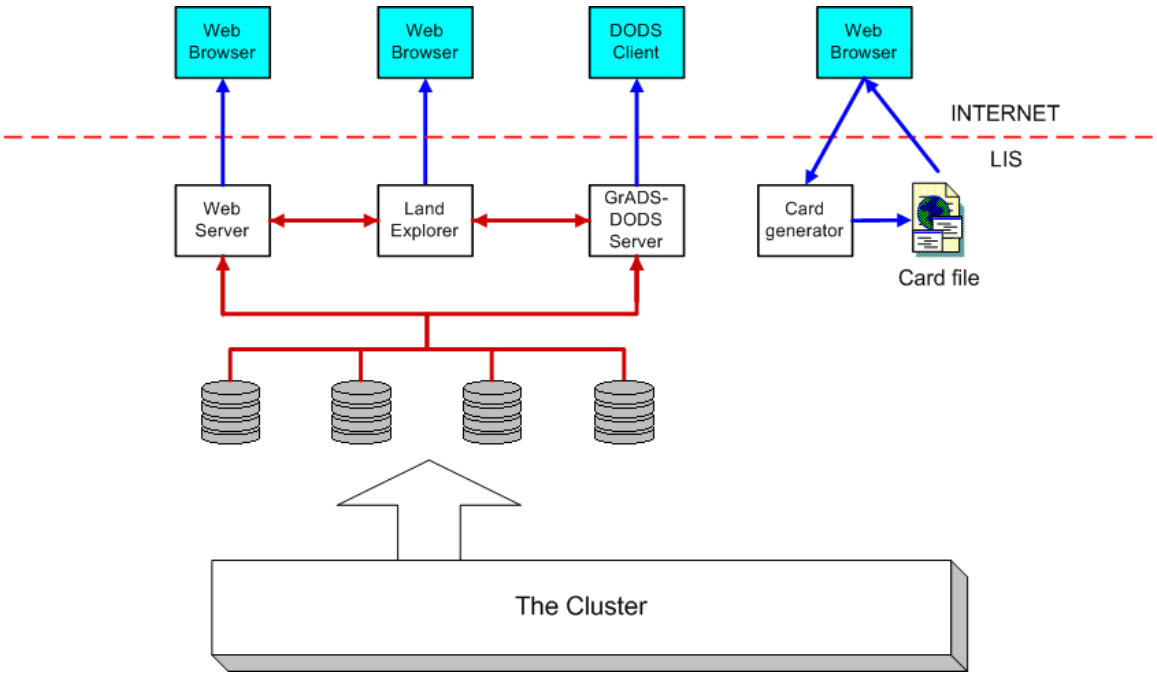

Figure 1: LIS user interface architecture

This diagram illustrates the levels of data access. The first arrow from the left represents Level 1 users, who will access static data using a Web browser. The remaining arrows represent Level 2 users, who will be accessing LIS data using the following three methods: 1) by using a Web browser to dynamically generate images and manipulate data; 2) by using a DODS client to manipulate a subset of data; and 3) by downloading an entire set of raw data via http. Level 2 users can also use a web browser to obtain a customized copy of the LIS configuration file to set up a LIS model run on their local machine, after the raw data has been downloaded.

Both user levels will be able to access the LIS user interface via a web browser, with an entry page as shown in Figure 2.

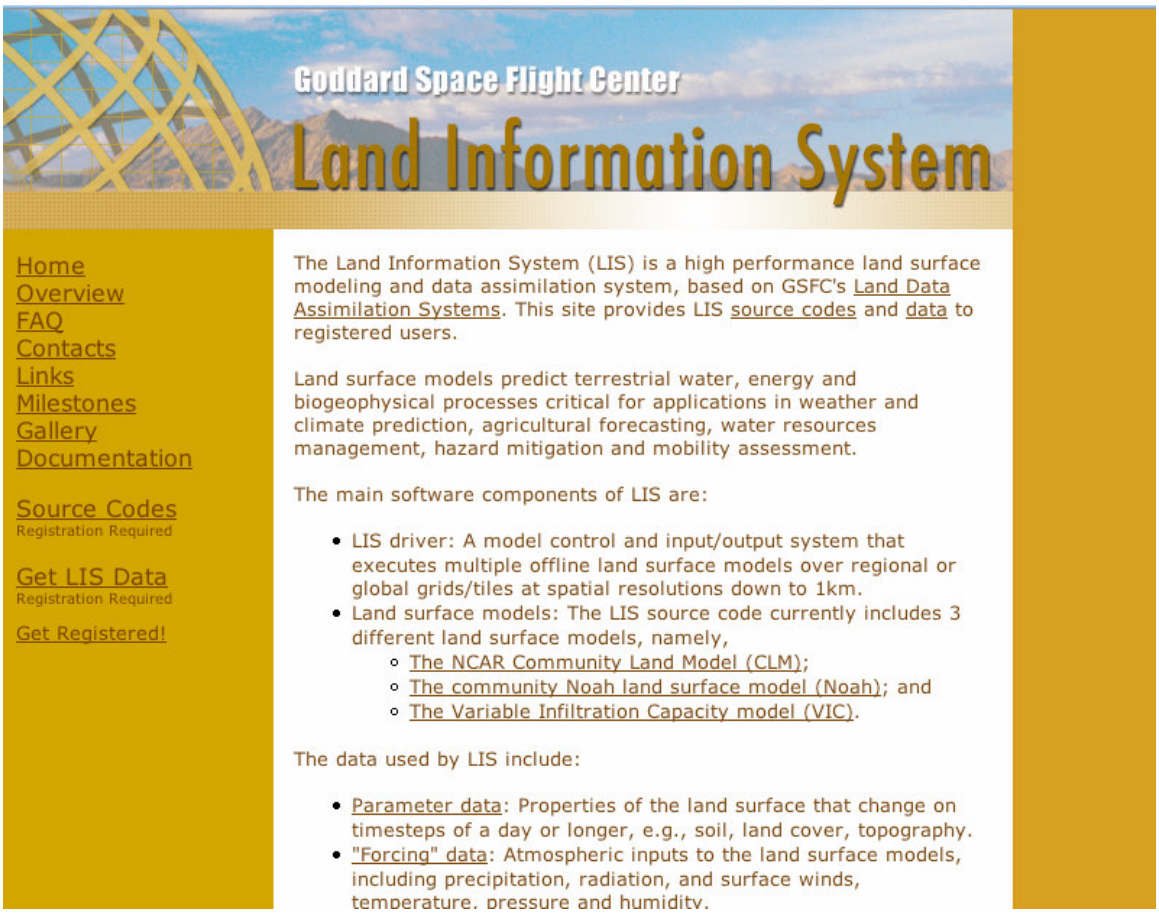

Figure 2: Screenshot of the LIS entry page

3 User levels and security design

As discussed above, outside users accessing the LIS are categorized into three levels, associated with different levels of data access and security requirements. This section describes the functionality and interface design associated with each user level.

3.1 Level 1 Users and the LIS Browser Interface

Level 1 users are the general public, who will access the LIS data through a standard web browser (LRD, Sec 6.2.1). Information provided to this class will only include static images and text. An image gallery will be created with images and scripts available for download (LRD, 6.2.1.1). This static content is served via the web server. This group of users does not have direct access to the data or LIS scientific computing power system, and their usage of system resources is very limited. Therefore, for this class of users we do not enforce any additional authentication or authorization procedures. It is also our intention to facilitate easy access to images for education and outreach purposes.

Data provided to Level 1 users will be as follows:

Overview: A short overview of the LIS project and its origins.

Contacts: Names and contact information for LIS team members and collaborators.

Links: Links to research related to LIS

Documentation/Source Code: All LIS Documentation and Source Code will be available to the public via the World Wide Web

Gallery: Images of LIS output data.

3.2 Level 2 Users, GrADS/DODS and Visualization

Level 2 users will have more direct access to LIS data. They will accomplish this by either dynamically generating an image via a web browser; by using a DODS client; or directly through an http download. The GrADS-DODS server provides the users with the ability and flexibility to get only a sub-set of the data they need. If the entire data set is desired, users will be able to directly download the raw data.

A Level 1 user must register with us before they can become a Level 2 user. Users will be required to fill out web forms, and their information will be stored on our server. Each time a Level 2 user logs in via the LIS web site, their username and password will be authenticated using CGI and Java scripts. Registration is being used to allow an extra layer of security between the World Wide Web user and the LIS hardware/software. The GrADS-DODS server will also impose a limit on system resource usages, as shown in Table 1 (LRD Sec. 9.5).

Table 1: Configurable GrADS-DODS parameters for access to level 2 users of LIS

Parameter	Description
Subset limit	Sets the maximum size in megabytes of a subset
Generate limit	Sets the maximum size in kilobytes of a generated dataset
Upload limit	Sets the maximum size in kilobytes of an uploaded dataset
Time limit	Sets the maximum time in milliseconds that a dataset generation task is allowed
Hit limit	Sets the maximum number of hits per hour permitted from a specific IP
Abuse limit	Sets that length of time in hours an IP address will be blocked out after exceeding the hit limit
Deny datasets	A comma delimited list of datasets that should not be accessible
Allow datasets	A comma delimited list of datasets that should be accessible

To visualize LIS data, we have two available methods: a web-based visualization system called "Land Explorer" (LE), and the Live Access Server (LAS). LE, which was developed “in-house”, is tightly integrated with the LIS GrADS-DODS server. It is designed to let users interactively visualize and explore LIS data at all resolutions, featuring an intuitive web interface and fast response. No special requirements, such as javascript, cookies, java applets, or pop-up windows are needed. Users can access LE by using a web browser to access the LIS GrADS-DODS server, located at http://lisdata.gsfc.nasa.gov:9090. Each variable will have a “Visualize” link that will allow users to use LE for that specific variable.

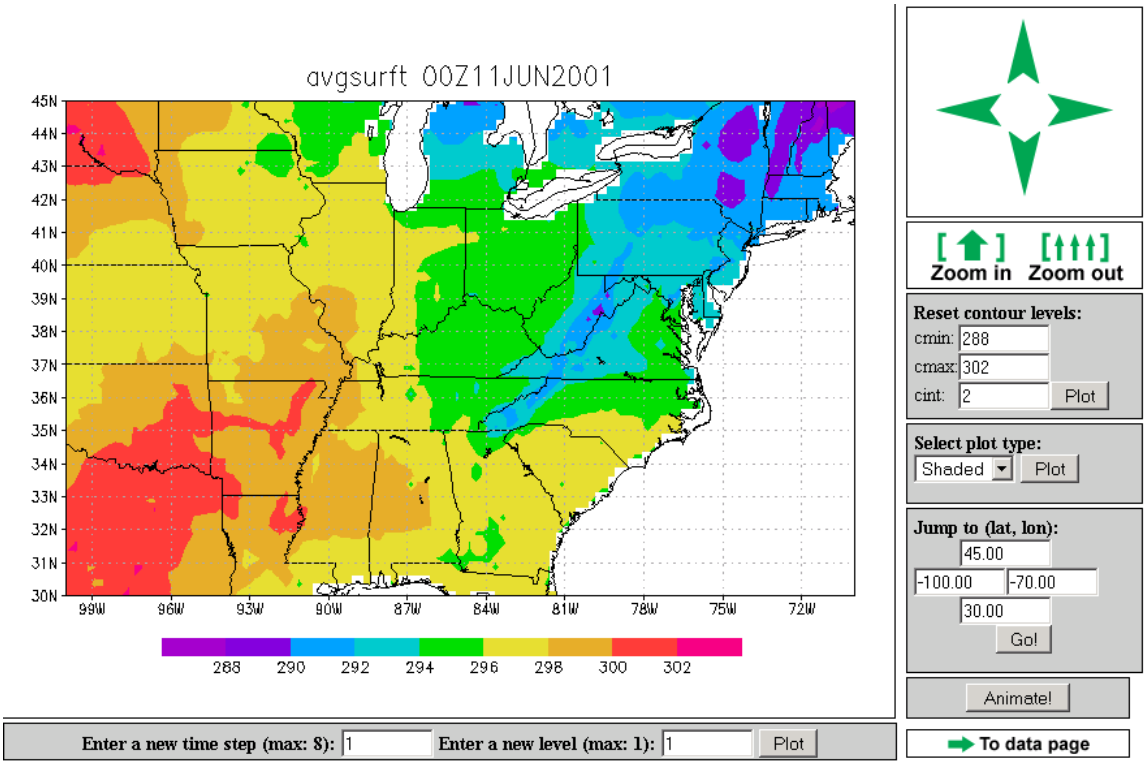

Figure 3: Land Explorer (LE)

LIS data will also be made available to Level 2 users who need direct access to the data in near real-time (LRD, Sec 6.2.2.1) using desktop software. Users who are utilizing a DODS client (GrADS, Matlab, IDL, etc.) will be able to directly manipulate subsets of LIS data through the DODS protocol. An HTTP server will also be in place to allow users to download raw data sets to their desktops as needed. All HTTP usage will be monitored and logged for security purposes (LRD, Sec. 9.4)

3.3 The LIS Card File Generator

The Land Information System Card File Generator allows registered users to customize a LIS model run. The LIS "card file" is a file that the LIS driver uses to set the parameters for a run. Some of these parameters are modifiable, and the Card File Generator allows users to modify these parameters using an HTML form. The form then processes the user's input and returns a copy of the card file to the browser.

To use the card file for a LIS run, use the browser's "save page" feature (or copy/paste) to save a copy onto your computer. The card file must then be placed into the directory where LIS will be run. For an in-depth look into the LIS card file and the available parameters, or for more information on running LIS, please review the LIS Users Guide.

The card file parameters are as follows:

Land Surface Model, consisting of CLM, VIC, or NOAH.

Spatial Resolution, consisting of 1km, 5km, 1/4 degree, 1/2 degree, 1 degree, and 2 by 2 and 1/2 degree.

Base Forcing data, consisting of GEOS or GDAS data.

Observed Forcing data, consisting of precipitation (CMAP) and radiation (AGRMET).

Temporal Domain, where the year, month, day, and time for the run are specified.

Grid Type, which has the types of grids supported by LIS.

Spatial Domain. Users can select the Parameter and the Execution Domain for their run.

LAI from MODIS, AVHRR, or user selected (Table-based) data.

Run-time options include restart capability, elevation correction, the ability to set the number of tiles per grid and the min % of a tile.

Output options include data format (binary or grib), writing output to a tile domain or grid, writing output to a single file or separate files, and the writing or forcing and parameter data (LRD, Sec 8.41 –8.42).

The LIS configuration interface will also have a selection for a LIS Land Surface Model Run online tutorial (LRD, Sec 10). The LIS configuration web interface is shown in Figure 4.

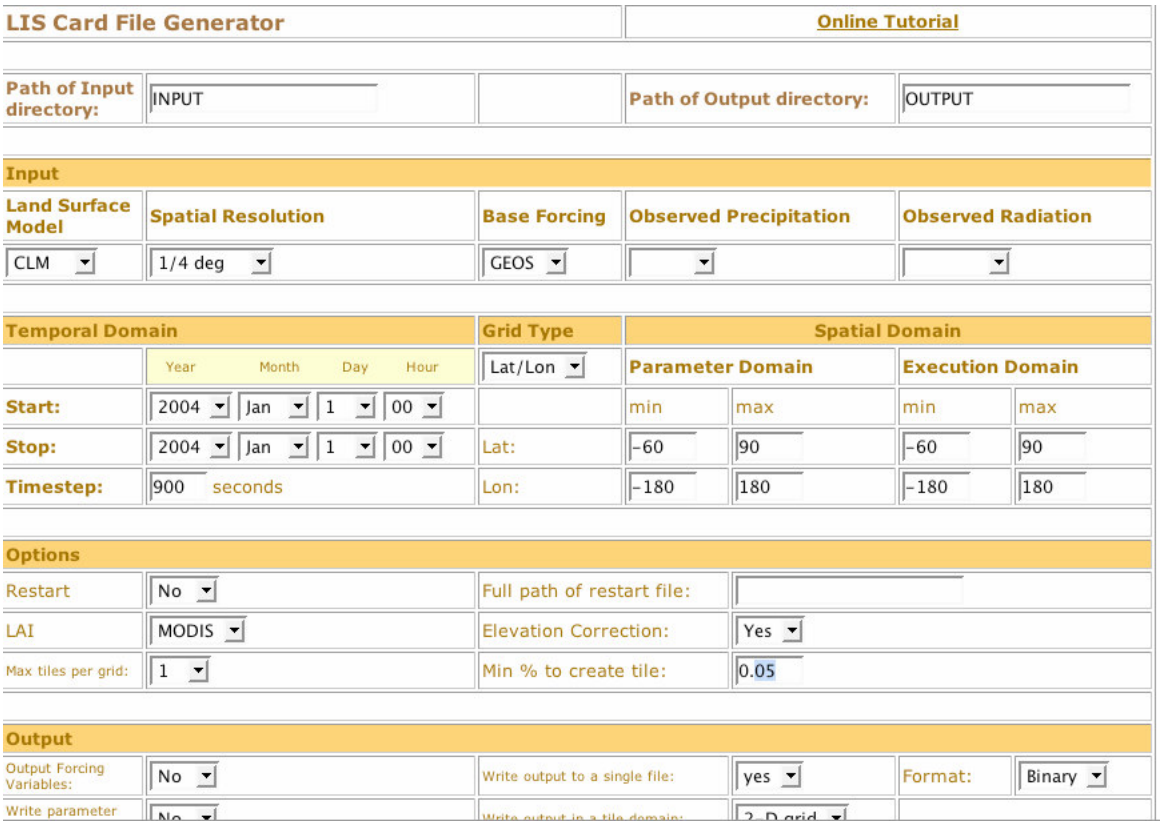

Figure 4: LIS Card File Generator

4 References

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Earth System Grid Quarterly Report, July 10, 2002 - http://www.earthsystemgrid.org/public/docs/ESGReportJuly02_final.doc

GrADS Home Page - http://grads.iges.org/grads/grads.html

Land Data Assimilation System (LDAS) - http://ldas.gsfc.nasa.gov/

LDAS GDS Image Generator - http://ldas.gsfc.nasa.gov/GLDASmap/testgds.html/

LDAS Real-Time Image Generator - http://ldas.gsfc.nasa.gov/map/riglive.html

LIS Requirements Document - http://lis.gsfc.nasa.gov/docs/Public/requirements.pdf

LIS Software Design Document - http://lis.gsfc.nasa.gov/docs/Public/LIS_swdd_8_13_2002.pdf

NCAR's Data Portal Efforts and The Earth System Grid presentation - http://www.dwd.de/UNIDART/Workshop/PowerPoint/MiddletonNCAR.ppt

NOMADS (NOAA Operational Model Archive and Distribution System) - http://data1.gfdl.noaa.gov

Thematic Realtime Environmental Data Distribution Services home page - http://www.unidata.ucar.edu/projects/THREDDS/